Summary

Embodiments of the invention are disclosed hereinafter for reducing the lateral size of an antenna array with reduced or weak mutual coupling by using a multi-tiered configuration. In particular, a common ground conductor, typically planar and single-tiered in a conventional antenna array, is multi-tiered by folding or corrugation to reduce the lateral spacing between plate array elements while maintaining the inter-element spacing.

In accordance with one aspect of the invention, there is disclosed an antenna array having a plurality of array elements, the antenna array comprising a first array element having a first suspended radiator and a first ground conductor, the first suspended radiator being displaced from the first ground conductor. The antenna also comprises a second array element being adjacent to the first array element, the second array element having a second suspended radiator and a second ground conductor, wherein the second suspended radiator is displaced from the second ground conductor. In the antenna array the first ground conductor is adjacent to and displaced from the second ground conductor and the first ground conductor is disposed on a first tier and the second ground conductor is disposed on a second tier to form an at least two-tiered unitary ground conductor.

In accordance with another aspect of the invention, there is disclosed a method for configuring an antenna array having a plurality of array elements, the method comprising the steps of providing a first array element having a first suspended radiator and a first ground conductor, the first suspended radiator being displaced from the first ground conductor, and providing a second array element as adjacent to the first array element, the second array element having a second suspended radiator and a second ground conductor, wherein the second suspended radiator is displaced from the second ground conductor. The method also comprises the steps of disposing the first ground conductor adjacent to and displaced from the second ground conductor, and disposing the first ground conductor on a first tier and the second ground conductor on a second tier to form an at least two-tiered unitary ground conductor.

same plane and form a lower tier or level with the corresponding plate array elements 114.

Each plate array element 114 comprises a suspended plate radiator and a corresponding ground patch, the ground patch being plate-like and part of the common ground conductor 116. The suspended plate radiator is fed with signals through conventional feeding means.

Since the common ground conductor 116 is corrugated, inter-element spacing D2 is greater than lateral spacing L2 in relation to two nearest adjacent plate array elements 114. By having the inter-element spacing D2 being substantially equivalent to the inter-element spacing D1 in the conventional rectangular plate antenna array 102, mutual coupling between the plate array elements 114 in this case is not worsened or increased. This is true even though the lateral spacing L2 is smaller than the lateral spacing L1 in the conventional rectangular plate antenna array 102.

The plate antenna array 122 as shown in Fig 1(c) includes plate array elements 124 arranged in a single row along the length of the rectangular plate antenna array 122 and has a symmetrical structure. The rectangular plate antenna array 122 also includes a rectangular and two-tiered common ground conductor 126 folded or corrugated longitudinally into alternating ridges 128 and grooves 129A and 129B, the grooves 129A and 129B not being of uniform widths. Specifically as shown in Fig. 1(c), in the middle of the rectangular plate antenna array 122 the central groove 129A is wider than the side grooves 129B as in the central groove 129A two plate array elements 124 are disposed. The ridges 128 are disposed on a same plane and form a higher tier or level with the corresponding plate array elements 124 while the grooves 129A and 129B are also disposed on a same plane and form a lower tier or level with the corresponding plate array elements 124.

Each plate array element 124 comprises a suspended plate radiator and a corresponding ground patch, the ground patch being plate-like and forming part of the common ground conductor 126. The suspended plate radiator is fed with signals through conventional feeding means.

Claims

1. An antenna array having a plurality of array elements, the antenna array comprising:

a first array element having a first suspended radiator and a first ground conductor, the first suspended radiator being displaced from the first ground conductor; and

a second array element being adjacent to the first array element, the second array element having a second suspended radiator and a second ground conductor, wherein the second suspended radiator is displaced from the second ground conductor,

wherein the first ground conductor is adjacent to and displaced from the second ground conductor and the first ground conductor is disposed on a first tier and the second ground conductor is disposed on a second tier to form an at least two-tiered unitary ground conductor.

2. The antenna array as in claim 1, wherein the first array element is immediately adjacent to the second array element.

3. The antenna array as in claim 1, wherein the first ground conductor is continuous with the second ground conductor.

4. The antenna array as in claim 1, wherein the inter-element spacing between the first array element and the second array element is greater than the lateral spacing therebetween.

5. The antenna array as in claim 1, wherein the antenna array is a plate antenna array.

6. The antenna array as in claim 5, wherein each of the first and second array elements is a plate array element.

7. The antenna array as in claim 6, wherein each of the first and second ground conductors is a ground patch.

8. The antenna array as in claim 7, wherein the first ground patch is continuous with the second ground patch.

9. A method for configuring an antenna array having a plurality of array elements, the method comprising the steps of:

providing a first array element having a first suspended radiator and a first ground conductor, the first suspended radiator being displaced from the first ground conductor;

providing a second array element as adjacent to the first array element, the second array element having a second suspended radiator and a second ground conductor, wherein the second suspended radiator is displaced from the second ground conductor;

disposing the first ground conductor adjacent to and displaced from the second ground conductor; and

disposing the first ground conductor on a first tier and the second ground conductor on a second tier to form an at least two-tiered unitary ground conductor.

10. The method as in claim 9, wherein the step of disposing the first ground conductor adjacent to and displaced from the second conductor includes disposing the first array element immediately adjacent to the second array element.

11. The method as in claim 9, further comprising the step of providing the first ground conductor as continuous with the second ground conductor.

12. The method as in claim 9, further comprising the step of providing the inter-element spacing between the first array element and the second array element as greater than the lateral spacing therebetween.

13. The method as in claim 9, further comprising the step of providing the antenna array as a plate antenna array.